CLAIMS:

1. A composition of matter comprising derivatized nanoparticles comprising inorganic nanoparticles having an attached metal-ion sequestrant, wherein said inorganic nanoparticles have an average particle size of less than 200 nm and the derivatized nanoparticles have a stability constant greater than 10^{10} with iron (III).

2. The composition of matter of claim 1 wherein said inorganic nanoparticles have an average particle size of less than 100 nm.

3. The composition of matter of claim 1 wherein said inorganic nanoparticles have an average particle size of less than 20 nm.

4. The composition of matter of claim 1 wherein said inorganic nanoparticles comprise silica oxides, alumina oxides, boehmites, titanium oxides, zinc oxides, tin oxides, zirconium oxides, yttrium oxides, hafnium oxides, clays, or alumina silicates.

5. The composition of matter of claim 3 wherein said inorganic nanoparticles comprise silicon dioxide, alumina oxide, clays or boehmite.

6. The composition of matter of claim 1 wherein said metal-ion sequestrant has a high stability constant for copper, zinc, aluminum or heavy metals.

7. The composition of matter of claim 1 wherein said metal-ion sequestrant has a stability constant for iron greater than 10^{20}.

8. The composition of matter of claim 1 wherein said metal-ion sequestrant has a stability constant for iron greater than 10^{30}.

9. The composition of matter of claim 1 wherein said metal-ion sequestrant comprises an alpha amino carboxylate functional group.

10. The composition of matter of claim 1 wherein said metal-ion sequestrant comprises a hydroxamate or a catechol functional group.

11. The composition of matter of claim 1 wherein the metal-ion sequestrant is attached to the nanoparticle, by reacting the nanoparticle with a metal alkoxide intermediate of the sequestrant having the general formula:

$M(OR)_{4-x} R'_{x}$;

wherein M is silicon, titanium, aluminum, tin, or germanium;
x is an integer from 1 to 3;
R is an organic group; and
R' is an organic group containing an alpha amino carboxylate, a hydroxamate, or a catechol functional group.

12. The composition of claim 11 wherein R' is a hydroxamate, or a catechol functional group.

13. The composition of matter of claim 1 wherein said metal-ion sequestrant is attached to the nanoparticle by reacting the nanoparticle with a silicon alkoxide intermediate of the sequestrant having the general formula:

$Si(OR)_{4-x} R'_{x}$;

wherein x is an integer from 1 to 3;
R is an alkyl group; and
R' is an organic group containing an alpha amino carboxylate, a hydroxamate, or a catechol functional group.

14. The composition of claim 13 wherein R' is a hydroxamate, or a catechol functional group.

15. The composition of matter of claim 1 wherein said nanoparticles have a specific surface area of greater than 100 m^2/g.

16. The composition of matter of claim 1 wherein said nanoparticles have a specific surface area of greater than 200 m^2/g.

17. The composition of matter of claim 1 wherein said nanoparticles have a specific surface area of greater than 300 m^2/g.

18. The composition of matter of claim 3 wherein said nanoparticles have a specific surface area of greater than 300 m^2/g.

19. The composition of matter of claim 1 wherein substantially all the metal-ion sequestrant is covalently bound to the nanoparticles.

20. The composition of matter of claim 1 wherein greater than 95% by weight of the nanoparticles have a particle size of less than 100 nm

21. The composition of matter of claim 1 wherein greater than 95% by weight of the nanoparticles have a particle size of less than 50 nm.

22. An article comprising immobilized derivatized nanoparticles, said derivatized nanoparticles comprising inorganic nanoparticles having an attached metal-ion sequestrant, wherein said inorganic nanoparticles have an average particle size of less than 200 nm and the derivatized nanoparticles have a stability constant greater than 10^{10} with iron (III).

23. The article of claim 22 wherein the derivatized nanoparticles are contained in a layer further comprising a binder, said layer being located on the surface of the article.

24. The article of claim 22 wherein the derivatized nanoparticles are incorporated into the materials forming the article.

25. The article of claim 22 wherein said inorganic nanoparticles have an average particle size of less than 100 nm.

26. The article of claim 22 wherein said inorganic nanoparticles have an average particle size of less than 20 nm.

27. The article of claim 22 wherein said inorganic nanoparticles comprise silica oxides, alumina oxides, boehmites, titanium oxides, zinc oxides, tin oxides, zirconium oxides, yttrium oxides, hafnium oxides, clays, or alumina silicates.

28. The article of claim 22 wherein said inorganic nanoparticles comprise silicon dioxide, alumina oxide, clays or boehmite.

29. The article of claim 22 wherein said metal-ion sequestrant has a high stability constant for copper, zinc, aluminum or heavy metals.

30. The article of claim 22 wherein said metal-ion sequestrant has a stability constant for iron greater than 10^{20}.

31. The article of claim 22 wherein said metal-ion sequestrant has a stability constant for iron greater than 10^{30}.

32. The article of claim 22 wherein said metal-ion sequestrant comprises an alpha amino carboxylate functional group.

33. The article of claim 22 wherein said metal-ion sequestrant comprises a hydroxamate or a catechol functional group.

34. The article of claim 22 wherein the metal-ion sequestrant is attached to the nanoparticle, by reacting the nanoparticle with a metal alkoxide intermediate of the sequestrant having the general formula:

$M(OR)_{4-x} R'_x$;

wherein M is silicon, titanium, aluminum, tin, or germanium;
x is an integer from 1 to 3;
R is an organic group; and
R' is an organic group containing an alpha amino carboxylate, a hydroxamate, or a catechol functional group.

35. The article of claim 34 wherein R' is a hydroxamate, or a catechol functional group.

36. The article of claim 22 wherein said metal-ion sequestrant is attached to the nanoparticle by reacting the nanoparticle with a silicon alkoxide intermediate of the sequestrant having the general formula:

$Si(OR)_{4-x} R'_x$;

wherein x is an integer from 1 to 3;
R is an alkyl group; and
R' is an organic group containing an alpha amino carboxylate, a hydroxamate, or a catechol functional group.

37. The article of claim 36 wherein R' is a hydroxamate, or a catechol functional group.

38. The article of claim 22 wherein said inorganic nanoparticles have a specific surface area of greater than 100 m^2/g.

39. The article of claim 22 wherein said nanoparticles have a specific surface area of greater than 200 m^2/g.

40. The article of claim 22 wherein said nanoparticles have a specific surface area of greater than 300 m^2/g.

41. The article of claim 26 wherein said nanoparticles have a specific surface area of greater than 300 m^2/g.

42. The article of claim 22 wherein substantially all the metal-ion sequestrant is covalently bound to the nanoparticles.

43. The article of claim 22 wherein greater than 95% by weight of the inorganic nanoparticles have a particle size of less than 100 nm.

44. The article of claim 22 wherein greater than 95% by weight of the inorganic nanoparticles have a particle size of less than 50 nm.

45. A method of removing target metal-ions from an environment comprising contacting the environment with a composition comprising derivatized nanoparticles comprising inorganic nanoparticles having an attached metal-ion sequestrant, wherein said inorganic nanoparticles have an average particle size of less than 200 nm and the derivatized nanoparticles have a stability constant greater than 10^{10} with iron (III).

46. The method of claim 45 wherein the environment is a liquid medium.

47. The method of claim 45 wherein the target metal-ion concentration in the liquid medium is reduced to less than 100 ppb.

48. The method of claim 47 wherein the target metal ion is iron.

49. The method of claim 48 wherein the iron concentration in the liquid medium is reduced to less than 50 ppb.

50. The method of claim 45 wherein said inorganic nanoparticles have an average particle size of less than 100 nm.

51. The method of claim 45 wherein said inorganic nanoparticles have an average particle size of less than 20 nm.

52. The method of claim 45 wherein said metal-ion sequestrant has a high stability constant for copper, zinc, aluminum or heavy metals.

53. The method of claim 45 wherein said metal-ion sequestrant has a stability constant for iron greater than 10^{20}.

54. The method of claim 45 wherein said metal-ion sequestrant has a stability constant for iron greater than 10^{30}.

55. The method of claim 45 wherein said metal-ion sequestrant comprises an alpha amino carboxylate functional group.

56. The method of claim 45 wherein said metal-ion sequestrant comprises a hydroxamate or a catechol functional group.

57. The method of claim 45 wherein said nanoparticles have a specific surface area of greater than 100 m^2/g.

58. The method of claim 45 wherein said nanoparticles have a specific surface area of greater than 200 m^2/g.

59. The method of matter of claim 45 wherein said nanoparticles have a specific surface area of greater than 300 m^2/g.

60. The method of matter of claim 51 wherein said nanoparticles have a specific surface area of greater than 300 m^2/g.

61. The method of claim 45 wherein greater than 95% by weight of the nanoparticles have a particle size of less than 100 nm.

62. The method of claim 45 wherein greater than 95% by weight of the nanoparticles have a particle size of less than 50 nm.